INNSPUB

Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 23, No. 1, p. 242-247, 2023
http://www.innspub.net

RESEARCH PAPER OPEN ACCESS

A GIS study on the intertidal marine debris: Basis on strenghtening policy implementation of R.A. 9003 in Tandag City, Philippines

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Article published on July 17, 2023

Key words: Solid waste, Beach litter, Coastal ecosystem, GIS

Abstract

Republic Act 9003 or the Ecological Solid Waste Management Act of 2000 aims to merge environmental protection with economic pursuits, recognizing the re-orientation of the community's view on solid waste, thereby providing schemes for waste minimization, volume reduction, resource recovery utilization and disposal. This study dwelt on the assessment of the inter-tidal marine debris in selected barangays of Tandag City using the Geographic Information Systems (GIS). Results showed that among all solid waste in the coastal and swamp area, the plastics materials (</> 5cm) ranks the highest percent of 71.01, followed by the others or minorities, recording a percent of 12.52. Cigarette butts/filters ranks third having a percent of 12.43. Lastly, metals got a percentage high abundance of solid wastes are rooted from the overlooked discarding of waste of the residents to the coastal area.

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Introduction

Solid Waste Management (SWM) identified as one of the serious urban environmental issues in the Philippines (Aguinaldo, 2008).Inorganic wastes have long lifespan before it decomposed and became an increasing problem in all the oceans and seas because of its indestructibility (Allen, 2017). Mostly inorganic wastes like plastics and soda bottles that protrude from the sand, plastics sheets and fabrics that are hanging over mangrove branches and littering the coastline are single-use sachets (Sarmiento, 2018). According to the World Bank report on 2001, a Filipino generates between 0.3-0.7 kilogram (kg) of waste daily and the annual waste generation was estimated at 10 million tons. The indiscriminate littering in coastal beaches by the community and by the tourists compromises the natural cycle of the ecosystem in the area. With this fact, both the macroplastics and microplastics posed a threat to marine organisms through ingestion or entanglement in the plastic (Li, *et al.,* 2016).

The Department of Environment and Natural Resources (DENR) has prioritized proper management of solid waste in its 12 points environmental agenda, as emphasized in the Republic Act 9003 declares the adaptation of a systematic, comprehensive, and ecological Solid Waste Management (SWM) program as a policy of the country and recognizes the local government units (LGUs) as the lead implementors.

In 2018, report of Ecological Solid Waste Management Office of Tandag City stated that the office collected 7,167.92 tons of wastes within the year. These wastes came from the 6 barangays only which include Bag-ong Lungsod, Bongtod, Dagocdoc, Mabua, San Agustin Sur, and Telaje. The wastes collected averages for about 19 – 30 tons per day. Furthermore, ESWMO reports that the collected biodegradables in the same year recorded 2,880.33 tons for the said six (6) barangays. The residual collected reach 2,436 tons, recyclable wastes reach 109.5 tons, and special wastes collected was recorded to reach 1,632.80 tons.

Republic Act 9003 sets the guidelines on waste reduction, however communities located in coastal areas which are not accessible by garbage trucks, makes the efforts of LGUs very limited. This paper therefore aims to present the experiences of selected barangays in Tandag City, the capital city of Surigao del Sur in the Philippines, and discuss the types of waste collected in coastal areas and the recyclable potential of these materials that can be a livelihood opportunity among residents. This can also be a step for an institutional and partnership strategies to create innovative program and local strategies, and continual monitoring and evaluation of waste generated in the coastal areas of the city.

Material and method

Study Site

Tandag City is the capital of Surigao del Sur which is located in between the municipalities of Cortes, Lanuza, San Miguel and Tago. The City of Tandag has a land area of 291.73 square km with a population of 56,364 according to 2015 census (PhilAtlas, 2019). As the population increases, more land are converted into residential area, even the coastal area.

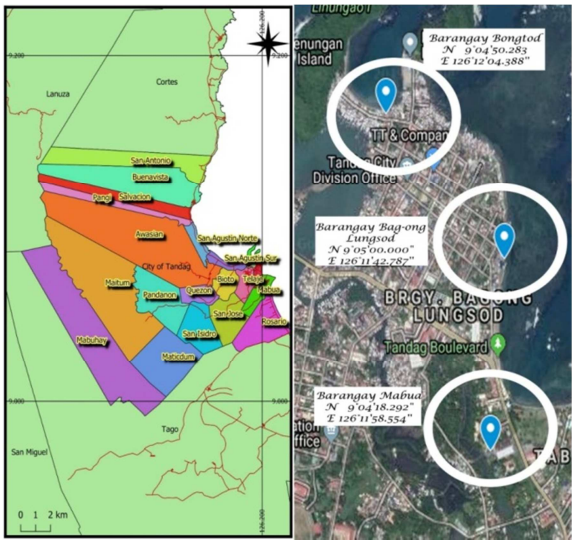

Fig. 1. Map of the study site (a) barangays of Tandag City (b) selected respondents barangays.

This situation puts high pressure on the coastal ecosystem. Also, dwellers in the coastal area contribute to the solid waste production in the coastal environment. The City of Tandag adopts and

implements RA 9003 or the Ecological Solid Waste Management Act of 2000 that mandates to adopt a systematic, comprehensive and ecological solid waste management program. It recently implemented a City Ordinance no. 11 of 2017, Section 13. Major Categories of Solid Wastes which mandates the segregation of all solid wastes products based on the categories of biodegradable, special wastes, residual and recyclable with corresponding color-coding (ESWMO).

Methodology

The study utilized the use of Geographic Information Systems (GIS) in visualizing the distribution of collected intertidal marine debris in the three (3) selected barangays of Tandag City. Global Positioning System(GPS) were collected as to indicate the area where the type of waste was gathered. Before going to the study sites, the following materials were prepared such as weighing scale, sacks and trash bags. A 100m rope was also set for the establishment of the transect line (Cheshire, *et al.*, 2009). Included also were gloves for protection against sharp and rusty objects; jacket, visor/cap face masks (Sneddon, 2014) for protection against the sun and dust; GPS device for getting the exact location of the areas were prepared. Notebook and ballpen for recording the data gathered from the plastic samples.

The researcher conducted a reconnaissance study to determine the sampling sites before the actual conduct. The three (3) sampling sites selected were: Brgy. Bag-ong Lungsod, Brgy. Bongtod, and Brgy. Mabua. During the actual study, the researcher recorded the exact location of the areas using the GPS device and measured 100 meters transect along the coastlines (Brgy. Bag-ong Lungsod and Brgy. Bongtod) and along the waterline of mangrove area in Brgy. Mabua. The M transect line was further divided into 10m zones as sample area. The UNEP/IOC Guidelines on Survey and Monitoring of Marine Litters was adopted in the study. The researcher collected, characterized, accounted and segregated the solid wastes present in the area (Cheshire *et al.*, 2009). The segregated inorganic samples were weighed and recorded. The process was done in the three (3) sampling sites.

Result and discussion

Categorical Findings of Solid Wastes and Beach Litters

The first problem of this study focused on the amount of the solid wastes and beach litters in the selected coastal barangays of Tandag City. The inorganic wastes were characterized as plastic materials which include disposable cups, plastic bottles, plastic wrappers (less or more than 5cm in length), and special plastics like toys, hangers, plates and drinking glasses, etc. The inorganic wastes are also characterized as metals which includes tin cans, metal fragments, copper wires, etc.; glass which includes glass bottles, glass fragments, fiber glass, etc. There were also cigarette butts/filters. The other wastes materials include fabric, rubber, nylon, nets and styrofoams.

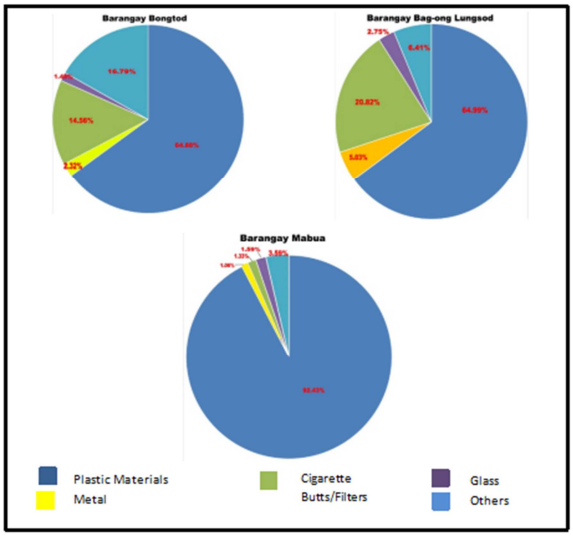

Fig. 2. Collected Solid Wastes in Three (3) Sampling Sites.

The charts showed the total amount of the collected solid wastes in the three (3) sampling sites – Brgy. Bag-ong Lungsod, Brgy. Bongtod, and Brgy. Mabua. Among the 5 categories of solid wastes given, plastic materials ranked first among the solid wastes collected in the three (3) sampling sites. This implies a greater risk to the blue carbon ecosystem present in the area. Most of the plastic materials are fragments of the original plastic wrapper, thus, these fragments can be ingested by marine organisms (Abreo, 2015) living in the seagrass meadows, or entangled in the seagrasses and seaweed in the area (Moore *et al.*, 2010; Schuyler *et al.*, 2012; Reisser *et al.*, 2013).

On the other hand, the collected cigarette butts/filters are high in Brgy. Bag-ong Lungsod and Brgy. Bongtod which indicates that smoking is rampant in these areas despite the implementation of anti-smoking ordinance of the city. This practice implicates risk in the health of the residents especially the children. The other wastes or minorities collected such as nylons and net fragments are also high in Brgy. Bongtod that signifies the dependency of the residents in fishing. Moreover, the metals collected are high in Brgy. Bongtod which composed of metal sheet fragments and copper wires. The glass collected in barangay Bongtod is higher compared to Brgy. Mabua and Brgy. Bag-ong Lungsod. The collected glasses are composed of empty liquor bottles and glass fragments.

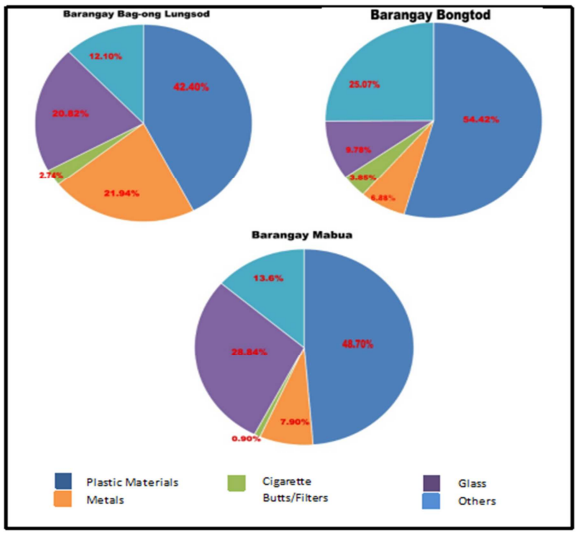

Fig. 3. Weight of Collected Solid Wastes from the Three (3) Sampling Sites.

The total plastic materials (54.42%), other wastes (nylon, net, diapers, fabric and rubber) (25.07%) and the cigarette butts/filter (3.85%) are heavier in Brgy. Bongtod compared to Brgy. Bag-ong Lungsod and Brgy. Mabua. This result is expected since the highest amount of these wastes are collected in Brgy. Bongtod. On the other hand, the weight of metals collected in Brgy. Bag-ong Lungsod and Brgy. Bongtod are almost the same. Although metals collected in Brgy. Bongtod are higher in number, those that were collected in Brgy. Bag-ong Lungsod are longer and heavier materials. In terms of the weight of glass collected, the sampling sites almost got the same. This implies that glass fragments from broken glasses may pose a potential threat to the community especially for the children who made the coastline their playground.

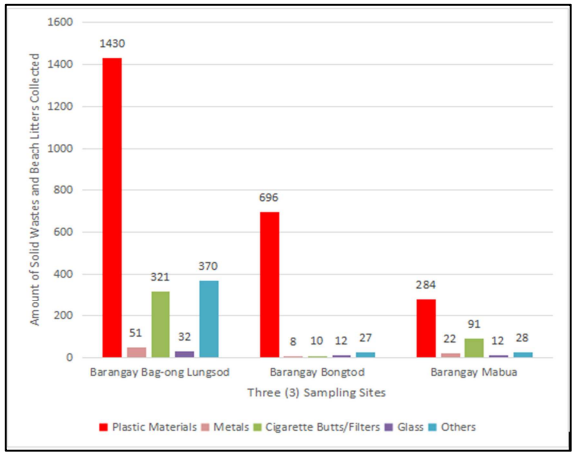

Fig. 4. Comparison of Collected Solid Wastes and Beach Litters in Three (3) Barangays.

It can be deduced from the fig. above highest percentage (64.94%) of the total collected wastes compared to the two barangays. This result implies that the community is dependent on single-use plastics for which are part of their daily activities. This finding coincides with the study of Kousha, *et al* (2014) claiming that plastics have become vital asset for humanity. Added to this, is the poor implementation of segregation of wastes which causes these materials to reach the coastlines and eventually end up to the seagrass beds and mangrove areas. In the case of Brgy. Mabua, it was noted that the collected plastic materials were stuck or buried in the sand. This may be because these wastes have been carried by the water during rainy seasons since there is the presence of drainage system which is connected to the river in the sampling area.

On the other hand, metals collected in Brgy. Bongtod comprises of metal fragments and rusted tin cans which have been oxidized by the sea breeze. While in Brgy. Bag-ong Lungsod, the metal fragments are from metal roofing sheets and some are copper wires that were originally from electric cables. Also. cigarette butts collected in the barangay indicates that the residents are either unaware of such policy or there is

a weak implementation of the policy from the LGU. The high amount of glass (fragments and liquor bottle) in Brgy. Bongtod may be attributed to the higher number of population near the coastline compared to the two (2) sampling sites. in addition, it was observed that in Brgy. Mabua were stuck/buried in the sand. Other wastes such as nets and nylons were evident in Brgy. Bongtod also because it is a fisherfolk community. However, those that are present in Brgy. Bag-ong Lungsod were diapers, fabrics, styrofoams which indicate that not all residents are dependent in fishing as their livelihood.

Distribution of Collected Wastes

The distribution of collected wastes was illustrated using maps. The maps are rendered using GIS technology through the utilization of 3.4 GIS software. The location of the three (3) barangays was shown in plot which was identified using the variation of GPS device. To show the concentration of wastes collected, the researcher used color variation. The concentration of the wastes collected was shown in different variation of colors. The darker the color, the more concentrated are the collected wastes in the area.

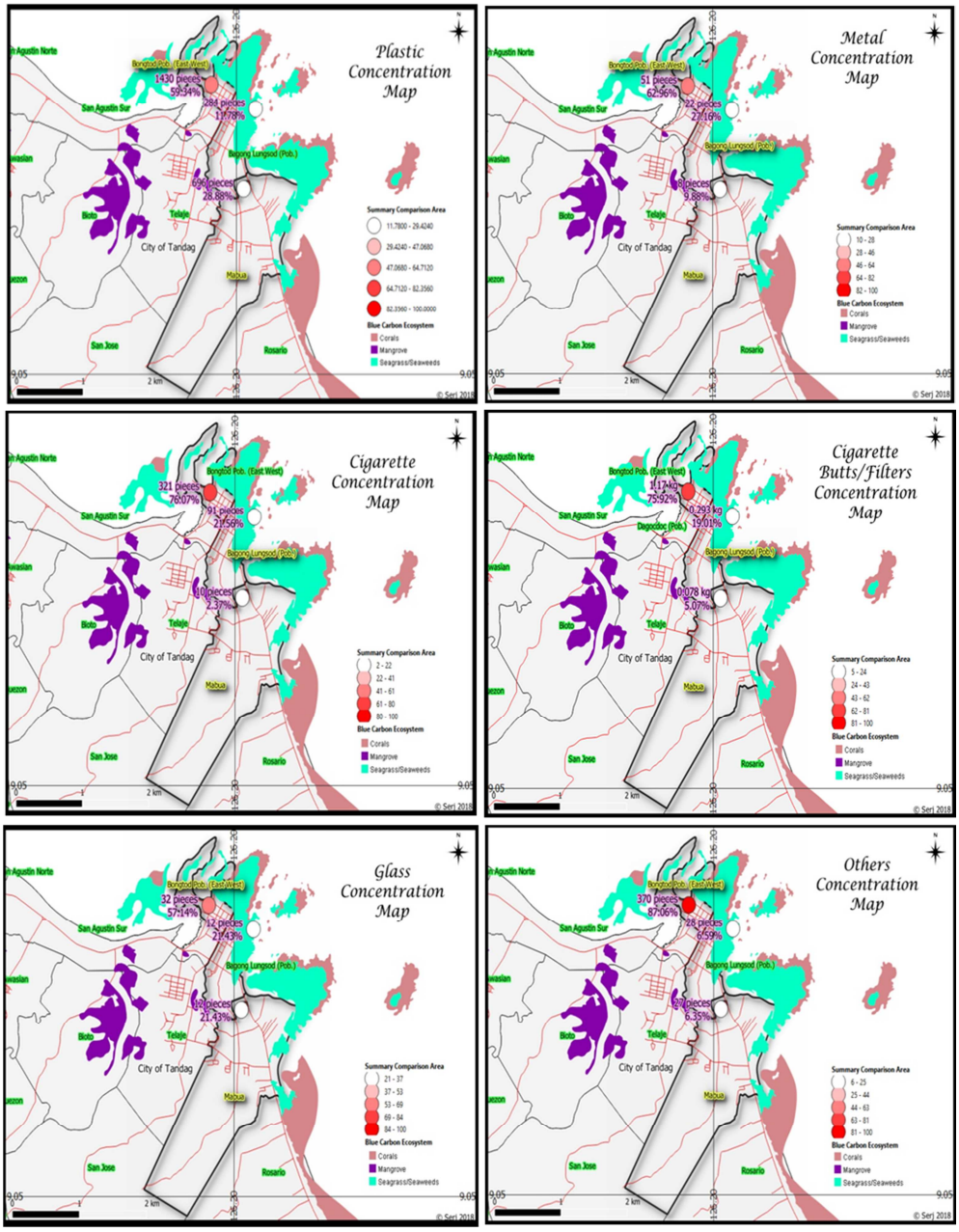

Fig. 5. Geographic Distribution of Collected Waste in three (3) barangays of Tandag City.

Conclusions

Majority of the solid wastes and beach litters (64.94%) collected in the sampling sites were from Brgy. Bongtod. The plastic materials among these wastes have the highest amount indicating the community's dependency and indiscriminate use of plastics in the area. Barangay Bongtod have the highest number of collected solid wastes and beach litters during the sampling. The indiscriminate disposal of wastes in the coastline is evident in the community indicating its low compliance on the City Ordinance no. 11 s. 2017. The abundance of plastic materials possesses a great threat to the blue carbon ecosystems that serve as catch basins of the materials (sediments, fertilizer, pesticides, wastes) from the highlands. Moreover, solid wastes especially, plastics accumulated in the ocean can be ingested and can cause entanglement of marine organisms which endangered them and in some ways affect also the human population.

National policies like RA 9003 will only be effective if they are accompanied by strong political commitment at the local government level in establishing supportive institutional framework as well as ensuring political will to implement innovative, strategic programs by allocating financial and organizational resources. Further, community participation is necessary to implement successful SWM program and that can be achieved when implemented programs provide economic incentives coupled with a strict enforcement scheme.

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